PUSH/PULL CLIP FEED CONFIGURATION FOR SELECTIVELY DELIVERING OR WITHDRAWING A CLIP TO ALLOW OUTPUT OF ONE CLIP ALONE OR TWO CLIPS CONCURRENTLY AND ASSOCIATED DEVICES, METHODS, SYSTEMS AND COMPUTER PROGRAM PRODUCTS

Related Applications

This application claims priority to U.S. Provisional Application Serial No. 60/470,327, filed May 14, 2003, the contents of which are hereby incorporated by reference as if recited in full herein.

Field of the Invention

The present invention relates to apparatus that can selectively apply closure clips to casing materials that enclose products therein.

Background of the Invention

Conventionally, in the production of consumable goods such as food or meat products, the food is fed (typically pumped) or stuffed into a casing in a manner that allows the casing to fill with a desired amount of the product. The casing can be produced so that it is sealed at selected locations to form a series of single discrete products or a series of linked "chubs."

One manner of producing a packaged product employs a piece goods packaging machine that can form a single or discrete packaged product or chub. In operation, a first clip is applied to the beginning portion of the casing, the casing is filled with product, and then a second clip is applied to the end portion of the casing. The process is repeated to provide a series of discrete piece good packaged products.

Another way of producing a packaged product employs a shirred casing machine that can be configured to produce a series of single products or a series of chained products. In operation, a clip is applied to the beginning portion of a casing and food is pumped into the casing and the filled casing is moved downstream from the filling point. The filling can be interrupted momentarily while excess product is voided (pushed away from a clip zone on the package) and two clips can be applied

concurrently to the casing at proximate but spaced apart lateral locations in the clip zone. A knife is used to separate the casing between the two concurrently applied clips to produce a sealed single package. This region between the two clips is sometimes described as the "tail" or end of the package. The first or forwardmost of the two clips forms the end of the forward (first) sealed product and the second or rearwardmost of the two clips forms the beginning of the next upstream package, which is now ready for filling which is restarted.

For certain consumable products, such as meat and/or sausage, there is often a desire to produce a series of closed packages that are linked or chained together. Thus, similar to the shirred single piece production method, two clips can be applied concurrently to a voided casing region, which action is repeated a number of times before cutting any of the links to generate a series or chain of linked "chubs." Thus, in operation, a desired number of chubs can be serially produced to form the desired length of product or number of chubs. This process can be described as a "chubbing operation." After the desired length of product and/or number of chubs is generated, the casing is voided and the two clips are concurrently applied to the casing as described above. The knife is then directed to cut the chain at the tail and start a new chain of linked product. The linked or chained products are typically vertically suspended together for further processing. *See, e.g.*, U.S. Patent Nos. 3,543,378, 5,167,567, 5,067,313, and 5,181,302, the contents of which are hereby incorporated by reference as if recited in full herein.

During a conventional chubbing operation, an unused (non-stuffed) length of casing or packaging material extends outwardly from the enclosed product between the first and second concurrently applied clips. The amount of unused length of casing can vary depending on the packaging machine, the type of package and/or product.

In certain applications, it is desirable to reduce the amount of unused lengths of casing to be able to do one or more of: reduce product costs (material cost savings), increase the amount of yield in the cooking facility, and suspend additional amounts of product or numbers of chubs on or in conventional racks for increased space utilization.

U. S. Patent No. 5,495,701 proposes a clip attachment mechanism for fastening a single clip or two clips simultaneously. The mechanism has two punches,

one of which is driven directly by a pneumatic cylinder and the other of which is connected to the first punch using a pin and key assembly. The pin and key assembly allows the punches to be coupled or decoupled to the pneumatic cylinder drive to apply one single clip or two clips simultaneously. U.S. Patent No. 5,586,424 proposes an apparatus for movement of U-shaped clips along a rail. The apparatus includes a clip feed for advancing clips on a guide rail and the arm is reciprocally driven by a piston and cylinder arrangement. The contents of each of these patents are hereby incorporated by reference as if recited in full herein.

Despite the foregoing there remains a need for devices and methods that can provide reduced amounts of unused casing material between adjacent sealed products and or additional links in a chain having a desired length for increased processing efficiency.

Summary of Embodiments of the Invention

Embodiments of the present invention provide devices, systems, methods and computer program products for selectively advancing and retracting clips along a clip feed path to automatically feed or withdraw a clip from a clip attachment mechanism to apply one closure clip alone or two closure clips concurrently to an encased product.

Certain embodiments are directed to methods for supplying a clip to a clip window associated with a closure attachment mechanism having a closure punch path for attaching a single clip or two clips to a target tubular work piece in a closure zone. The method includes: (a) forcing a plurality of clips to travel in a first predetermined clip travel path having a forward direction toward a first punch path in a closure zone at a first point in time; (b) selectively retracting the plurality of clips so that the clips travel in a reverse direction along the first predetermined clip travel path; and then (c) forcing the plurality of clips to again travel in the forward direction along the first predetermined clip travel path at a second point in time.

The forcing steps can be carried out by pushing the clips forward along a clip feed path and the retracting step can be carried out by pulling the clips rearward along the clip feed path.

Other embodiments are directed to methods for supplying a clip to a clip window associated with a closure attachment mechanism having a closure delivery

path for allowing attachment of a single clip or two clips to a target tubular work piece in a closure zone. The methods include: (a) pushing a plurality of clips to travel in a first predetermined clip travel path having a forward direction toward a first closure delivery path in a closure zone at a first point in time; (b) selectively pulling the plurality of clips so that the clips travel in a reverse direction along the first predetermined clip travel path; and then (c) pushing the plurality of clips to again travel in the forward direction along the first predetermined clip travel path at a second point in time.

Other embodiments are directed to apparatus for supplying a clip to a clip window associated with a closure attachment mechanism having a closure delivery path for attaching a single clip or two clips to a target tubular work piece in a closure zone. The apparatus includes: (a) means for forcing a plurality of clips to travel in a first predetermined clip travel path having a forward direction toward a first closure delivery path in a closure zone at a first point in time; (b) means for selectively retracting the plurality of clips so that the clips travel in a reverse direction along the first predetermined clip travel path; and then (c) means for forcing the plurality of clips to again travel in the forward direction along the first predetermined clip travel path at a second point in time.

The apparatus may include means for holding the plurality of clips above a first clip window associated with the first closure delivery path in the closure zone for a desired interval, the interval associated with the number of target tubular workpieces that pass through the closure zone without receiving a clip from the first closure delivery path.

Still other embodiments are directed to systems for attaching closure clips to elongate or tubular products held in casing materials. The systems include: (a) a curvilinear clip rail having opposing top and bottom end portions and defining a generally downwardly extending clip feed direction; (b) a clip entry window in communication with the bottom end portion of the clip rail and a clip closure delivery path in communication with an attachment mechanism that is adapted to wrap a clip about a target tubular work piece; (c) a clip pusher configured to selectively engage with clips held on the clip rail to force the clips in the feed direction; and (d) a clip retraction assembly configured to selectively engage with clips held on the clip rail to force the clips away from the clip window and away from the clip feed direction.

In certain embodiments, the systems may also include: (e) a first actuation cylinder in communication with the clip pusher; (f) a second actuation cylinder in communication with the clip retraction member; and (g) a control module configured to direct the actuation of the first and second cylinders to selectively feed (and hence not continuously feed) a clip through the clip window.

Still other embodiments are directed to computer program products for operating a shirred casing voiding/clipping apparatus having two proximate clip attachment mechanisms with first and second clip travel paths to selectively deliver one clip or two clips concurrently to a chain of linked chub product. The computer program products include a computer readable storage medium having computer readable program code embodied in the medium. The computer-readable program code includes: (a) computer readable program code that controllably actuates a first actuation cylinder to push clips in a first clip feed direction; and (b) computer readable program code that controllably actuates a second actuation cylinder to pull clips away from the clip feed direction.

In certain embodiments, the computer readable program code can allow a user to select a desired number of links of chubs and/or a desired chain length of linked chubs and computer program code that directs the first and second actuation cylinders to apply the appropriate number of single and dual clips at the appropriate links in the chain.

These and other objects and/or aspects of the present invention are explained in detail in the specification set forth below.

Brief Description of the Drawings

Figure 1 is a side elevation view of a prior art apparatus used to apply clips via a clip punch attachment mechanism.

Figure 2A is a block diagram of operations that can be carried out according to embodiments of the present invention.

Figure 2B is a schematic diagram of a linked product having singular and dual closure clips according to embodiments of the present invention.

Figure 3 is a schematic illustration of components of embodiments of the present invention.

Figure 4 is a flow chart of operations that can be carried out according to embodiments of the present invention.

Figure 5 is a perspective view of a clip retraction assembly according to embodiments of the present invention.

Figure 6 is a right side view of the retraction assembly of **Figure 5** in an exemplary rest position according to embodiments of the present invention.

Figure 7 is a front view of the retraction assembly shown in **Figure 6** in the exemplary rest position.

Figure 8A is a back view of the retraction assembly shown in **Figure 5** with the clip pusher assembly in an extended state and the clip pusher engaged with clips to advance same along a feed direction according to embodiments of the present invention.

Figure 8B is a back view of the retraction assembly shown in **Figure 8A** with the clip pusher assembly in a retracted state and the clip pusher disengaged from the clips.

Figure 9A is a front view of the clip retraction assembly shown in **Figure 5** illustrated with the clip retraction cylinder in a retracted state and the retraction jaw engaged with the clips according to embodiments of the present invention.

Figure 9B is a back view of the clip retraction assembly shown in **Figure 5** with the clip retraction cylinder in the retracted state and the retraction jaw engaged with clips while the pusher is disengaged.

Figure 9C is a bottom view of the clip retraction assembly shown in **Figure 9B** with the retraction jaw disengaged.

Figure 10 is a block diagram of a data processing system according to embodiments of the present invention.

Description of Embodiments of the Invention

The present invention will now be described more fully hereinafter with reference to the accompanying figures, in which embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Like numbers refer to like elements throughout. In the figures, certain layers, components or features may be exaggerated for clarity, and broken lines illustrate optional features or

operations unless specified otherwise. In addition, the sequence of operations (or steps) is not limited to the order presented in the claims unless specifically indicated otherwise. Where used, the terms "attached", "connected", "contacting", "coupling" and the like, can mean either directly or indirectly, unless stated otherwise. The term "concurrently" means that the operations are carried out substantially simultaneously.

In the description of the present invention that follows, certain terms are employed to refer to the positional relationship of certain structures relative to other structures. As used herein, the term "front" or "forward" and derivatives thereof refer to the general or primary direction that the clips travel toward a target product for closure and/or the direction that the target filled or stuffed product in casing material travel; this term is intended to be synonymous with the term "downstream," which is often used in manufacturing or material flow environments to indicate that certain material traveling or being acted upon is farther along in that process than other material. Conversely, the terms "rearward" and "upstream" and derivatives thereof refer to the directions opposite, respectively, the forward and downstream directions.

The present invention is particularly suitable for applying closure clips to seal flexible products held in casings. The product may be a linked chain of elongated extruded product held in a casing. The casing can be any suitable casing (edible or inedible, natural or synthetic) such as, but not limited to, collagen, cellulose, plastic, elastomeric or polymeric casing. The elongated or tubular product can be an elongated meat product. Exemplary meat products include, but are not limited to, strands of meat (that may comprise pepperoni, poultry, and/or beef or other desired meat), and processed meat products including whole or partial meat mixtures, including sausages, hotdogs, and the like. Other embodiments of the present invention may be directed to seal other types of food (such as cheese) or other product in casing materials. Examples of other products include powders such as granular materials including grain, sugar, sand, sand and the like or other flowable materials including wet (similar to that held conventionally in cans) pet food or other powder, granular, solid, semi-solid or gelatinous materials. The product may be a packaged in any suitable industry including food, aquaculture, agriculture, environment, chemical, explosives, or other application.

The elongated product can be produced in a linked chain of tubular or chub product. The length and diameter of each link or chub as well as the overall length of

the chain can vary depending on the type of product being produced. Examples of typical strand or chain lengths are between about 1-6 feet.

Generally stated, clips are applied to the casing material to wrap around and close or seal the product therein. The seal formed by the clip against the casing may be sufficiently strong so as to be able to hold a vacuum of about 16mm Hg for about 24-48 hours. Examples of suitable clips include metallic generally "U" -shaped clips available from Tipper Tie, Inc., in Apex, North Carolina. Other clips, clip materials and clip configurations may also be used.

Referring to **Figure 1**, one example of a prior art clip attachment apparatus with a clip advancement mechanism is illustrated. Typically, the clip attachment apparatus includes a housing **10** that defines a closure delivery path or channel **12** for receipt of a U-shaped metal clip **14**. The clip **14** is advanced in the closure path or channel **12** by means of a punch **16** so that the clip **14** will engage a die **18** positioned in a manner permitting the clip **14** to be formed about gathered material **20** that encases the product in the material **20** at closure zone **20z** in the product travel path. Although not illustrated, pressurized air or other means of pressing or moving the clip to close about the tubular package may also be used.

Each clip **14** is typically fed from a clip guide rail **22** through a clip window **24** into the closure path or channel **12** so that a respective one of the clips can be aligned in the path **12**. As shown, the guide rail **22** has a curvilinear configuration with a vertical run **23** which is curved at its lower end so that it gradually merges into a horizontal run **25** to direct clips **14** mounted thereon into the window **24**. As shown in **Figure 1**, the clips **14** are typically arranged in a stack **15** with adjacent clips **14** abutting each other so that the legs **26** of each clip **14** fit around the guide rail **22** with a crown **28** of each clip **14** fitting over the guide rail **22**. The multiple clips **14** may be connected to one another by means of a thin elastomeric film, tape or adhesive **30** (typically along the crown **28**) so that the clips **14** together may slide down the guide rail **22** and around the bend therein between the vertical and horizontal runs **23, 25** of the guide rail. Typically, clips **14** are provided in a coil or on a reel **34** for feeding onto the guide rail **22**. The reel **34** is schematically depicted in **Figure 1** for feeding of the clips **14** onto the guide rail **22**. Although illustrated herein as a generally vertical and downwardly directed clip feed, other feed orientations (upward, lateral, angular or the like) may also be used.

Turning now to **Figure 2A**, operations that can be used to carry out embodiments of the invention are shown. A plurality of clips are forced (by gravity and/or active propulsion) to travel in a first predetermined clip travel path having a forward feed direction toward a first closure delivery path (such as a punch path) in a closure zone at a first point in time (**block 100**). The plurality of clips are selectively retracted so that the clips travel in reverse along the first predetermined clip travel path (so that no clip is fed into the clip window) (**block 105**). The clips are then forced to travel in the forward feed direction along the first predetermined travel path at a second point in time (**block 110**).

The forcing operations can be carried out by urging a push pawl against one or more of the clips to force the clips to travel in a generally downward and/or forward direction (**block 101**). The retracting operation can be carried out by using a retraction jaw that can close about the exterior of at least one (typically a plurality) of clips to draw the clips away from the clip window or punch channel (**block 106**). The forward and reverse motion of the clips (which may be carried out by pushing and pulling the clips) can be automatically performed using a control module that actuates cylinders associated with a respective one of the push pawl and retraction jaw to direct the timing thereof (**block 109**). When the clips are moved forward, a clip can be fed through the channel **12** (**Figure 1**) to close about an underlying product; when the clips are retracted, although a punch may still operate in the channel **12**, it punches a blank or air as no clip is in the channel. This method allows a single clip to be applied to a plurality of the tails of the chubs while the dual clips are applied only to selected chubs (such as the chubs at the beginning and/or end of the chain).

Figure 2B illustrates an example of a chain of linked product **20ch** that includes clips **14** applied both singularly and in pairs concurrently. As shown, the chain of linked product **20ch** includes a forward chub L_1, intermediate chubs L_2-L_4, and a rearward chub L_5. The forward chub and the rearward chub, L_1, L_5 have two clips **14** wrapped thereabout concurrently to form closed clips **14c** at a forward tail and one closed clip **14c** at a rearward tail (positions marked as "A). The intermediate links L_2-L_4 have a single clip **14** applied to voided casing material **20** (marked as positions "B"). A loop may be added to the forward or rearward tail to hang the chain on a subsequent processing apparatus as desired (not shown). The sealed product can

be cut between the dual applied clips at position A as indicated by the knife position "K" to release the chain **20ch** and start a new chain as desired.

Figure 3 is a schematic illustration of certain components that may be included in a system **111** according to embodiments of the present invention. It will be appreciated that in certain embodiments, two proximately positioned clip attachment mechanisms can be used each with its own clip feed. One clip attachment mechanism can be configured to substantially continuously apply a closure clip to the product with each cycle during production of a chain and the other clip attachment mechanism can be configured to selectively apply a closure clip to the product as described above. As shown in **Figure 3**, the system can include a controller **112** that may be configured to direct the actuation of a retraction actuation cylinder **210** and first and second pusher actuation cylinders **310, 310_2**. The controller **112** may also be configured to control the operation of a voiding plate(s) actuation mechanism **116** that can be used to clear the filler material from the casing **20** (**Figure 1**) before the closure clip is attached thereto, as is well known to those of skill in the art. The controller **112** can be used to separately and/or jointly actuate (typically in concert) both the first and second attachment punch mechanisms **118_1, 118_2** (that may engage punch **16** as shown in **Figure 1**, or a different punch or attachment mechanism) associated with the first and second clip attachment mechanisms. The controller **112** may also be configured to direct the actuation of the knife actuation mechanism **114** that is used to separate serial chains between closure clips.

Figure 4 is a flow chart of operations that can be used to automate the closure process according to embodiments of the present invention. Clips are fed on a feed rail to a clip window in communication with a clip attachment mechanism (**block 120**). It is determined whether a dual clip delivery is desired at this time. If no, it is decided whether a single clip delivery is desired (**block 125**). If it is determined that a dual clip delivery is desired, the retraction cylinder is held in a retracted state and the clip pusher cylinder can be extended (**block 123**). It is then determined whether a single clip delivery is desired (**block 125**); if not, it can be queried again whether another dual clip is desired (**block 121**) or whether to ask for operator input (**block 126**). If single clip delivery is desired, the pusher cylinder is retracted and the retraction cylinder is actuated to retract the clips away from the clip window (**block 127**). Sensors can obtain data that can be interrogated to determine whether the

desired number of links and/or desired length of chain has been produced (**block 129**). It can be determined whether the link is the last in the chain. If so, a new chain can be started after applying two clips (**block 123**). If no, the retraction cylinder can be maintained in its engaged position with the clips held away from the clip window (**block 127**).

Figure 5 illustrates one embodiment of a retraction assembly **200** with a retraction assembly actuation cylinder **210**. Also shown is a clip advancement mechanism **300** with its respective actuation cylinder **310**. As shown, the retraction assembly **200** includes a retraction jaw **225** with legs **226, 227** that are pivotably attached to a mounting bracket **225m** at a corresponding first end portion thereof **226p, 227p**. The mounting bracket **225** is operatively associated with the cylinder **210** and moves up and down as the cylinder **210** is actuated, as will be discussed further below.

Still referring to **Figure 5**, the retraction jaw **225** can include an extension spring **228** that extends between the legs **226, 227**. Each leg **226, 227** may include an aperture **226a, 227a** with a pin **229** extending across that can hold opposing ends of the spring **228** to bias the legs **226, 227** to move toward each other in operation. In certain embodiments, the spring **228** can be a coil spring, which can apply a desired biasing spring force to help bring the legs **226, 227** together. An example of a suitable spring is a spring made from 0.026 stainless steel wire with a standard 1" length. The spring ratings can be about 2.43 pounds per inch (typically about +/- 10%) with a deflection at load of about .94 and a load of about 2.66 in-lb. The spring length at mechanism rest is about 1.727 inches and the spring length at mechanism engaged is about 1.233. Typically, there is little force (such as less than about 1.5 in-lb) applied to the retraction legs **226, 227** and/or fingers **226f, 227f** to bring them together.

The retraction jaw **225** can also include two jaw stop pins $\mathbf{230_1}$, $\mathbf{230_2}$ that reside inside of and below the first end portions of the legs **226, 227**. The jaw stop pins $\mathbf{230_1}$, $\mathbf{230_2}$ may be alternately configured as a single pin or track that can extend across the jaw retraction bracket or frame **225** a sufficient distance to engage both legs **226, 227**. The second end portions **226c, 227c** are configured to engage the clips **14** to move the clips **14** away from the clip window **24** and/or the clip closure path **12** (**Figure 1**). As shown in **Figure 5**, the second end portions **226c, 227c** are lower

portions of the legs **226, 227** which include outwardly extending fingers **226f, 227f** that can be configured to straddle a portion of the outer perimeter of the clip **14** (**Figure 9A**). As shown, the fingers **226f, 227f** can extend across a major portion of the length of the clip legs **14L** (**Figure 9C**) leaving the crown **14C** (**Figure 9C**) area substantially open. However, other gripping or contacting configurations may also be used as long as sufficient force is applied to the clips **14** to be able to selectively and controllably retract them away from the clip window **24** (**Figure 1**) and, in certain embodiments, so as to be able to hold the clips **14** in a retracted position for a desired interval.

Figure 6 illustrates the retraction assembly **200** and the clip advancement assembly **300** with the retraction assembly **200** and retraction jaw **225** in a rest position and with the cylinder **210** placing the rod **210r** in an extended position. **Figure 7** also illustrates the retraction assembly **200** and retraction jaw **225** in the rest position with rod **210r** actuated to the extended position and the legs **226, 227** of the jaw **225** spread apart and disengaged from the clips **14**. During normal operation (in which single clip applications are not used), the system may be operated so as to leave the jaw retraction cylinder **210** with the jaw legs open, which allows the clip pusher cylinder **310** to cycle during each machine cycle (as shown in **Figure 8A**).

As shown in **Figure 9A**, the fingers **226f, 227f** extend outwardly a distance sufficient to straddle opposing sides of the clip or clips **14** (shown as contacting two abutting clips **14**) and the inner surface of the fingers **226f, 227f** can be formed with a tooth profile that, upon contact, can mate with the profile of abutting clips **14**. Other gripping configurations can also be used. For example, the fingers **226f, 227f** may include surfaces with materials which can frictionally engage the clips **14**, such as elastomeric or rubber coatings. In addition, the retraction jaw may be configured to engage only one side of the clips or other portions of the clips.

Figure 8A illustrates the clip advancement assembly **300** with the associated pusher actuation cylinder **310** in operation and with the rod **310r** in an extended state. A pusher pawl **325** is pivotably mounted to the bracket **325m** at pivot **325p**. The pusher pawl **325** may also be spring loaded with a torsion spring (not shown) to help provide sufficient downward force onto the clips **14**. The pusher pawl **325** includes a forward edge **325e** portion that engages a clip or clips on the rail **22**. The forward edge portion **325e** may be configured as a protruding tooth which can enter (from a

side) the space between abutting clip legs as shown in **Figure 8A**. The rod **310r** is connected to a mounting bracket **325m** and can move the mounting bracket **325m**, and in turn, pusher **325**, in a desired reciprocating motion. The pusher pawl **325** may also include a manual disengagement lever **326**.

As also shown in **Figure 8A**, the clip advancement assembly **300** can include a stop anvil **328** that can be positioned above the pusher pawl **325**. The stop anvil **328** can have a downwardly extending portion **328d** that, in operation, forces the pusher pawl **325** to pivot down and disengage the clips **14** as shown in **Figure 8B** when the cylinder **310** has the rod **310r** in a retracted state. **Figure 8B** show both the clip advancement assembly **300** with the associated cylinder **310** and the clip retraction assembly **200** with the associated cylinder **210** in a rest state (*i.e.*, neither engaged with clips).

Figure 9A illustrates the retraction assembly **200** with the retraction cylinder **210** actuated to place rod **210r** in a retracted state and with the jaw **225** engaging the clips **14** to direct the clips **14** to retract (as indicated by the arrow located adjacent the clip rail **22**). **Figure 9B** illustrates the configuration of the advancement assembly **300** when the retraction assembly **200** operatively engages the clips **14**. As shown, the pusher pawl **325** is pivoted down so that it does not engage the clips **14** while the clip jaws **225** are engaged to retract the clips **14**. **Figure 9C** illustrates the configuration of the jaw **225** with respect to the clip when not engaging the clips **14**. As shown, in this embodiment, the clips **14** include a crown **14c** and two opposing legs **14L**. However, as noted above, the present invention can be used with other clip configurations.

Referring again to **Figure 7**, as the retraction cylinder **210** is extended (moving toward a rest state), legs **226**, **227** move down and the upper portions thereof **226u**, **227u** approach the stop pins $\mathbf{230_1}$, $\mathbf{230_2}$. The inner surfaces of the legs **226i**, **227i** act as cam followers, with the jaw stop pins $\mathbf{230_1}$, $\mathbf{230_2}$ acting as the cam. Thus, as the legs **226, 227** move down responsive to the rod **210r** moving into the extended state, the legs **226, 227** are forced apart. The jaw stop pins $\mathbf{230_1}$, $\mathbf{230_2}$ can be statically mounted to remain in a fixed position on the retractor assembly **200** (and/or pusher assembly **300**).

As shown herein, the cylinders **210** and **310** move respective brackets **225m**, **325m** along a generally vertical actuation axis. However, other actuation orientations

may also be used with other clip attachment and/or clip feed configurations. In addition, as shown, the clip advancement assembly **300** is located above the clip retraction assembly **200** so that the advancement assembly **300** pushes the clips **14** in the feed direction and the retraction assembly **200** pulls the clips away from the clip window in the reverse direction. However, the two assemblies **200, 300** can be positioned in the reverse or even at the same vertical position.

The cylinders **210, 310** can be double-acting. As is well known to those of skill in the art, fluid (typically pneumatic) pressure is provided against the surface of the piston to provide a substantially constant and controlled driving force for the respective assembly **200, 300**. When the piston reaches the lower end (or upper end) of its run within the cylinder, the fluid driving forces can be reversed so that the piston can return to its initial driving position at the top or bottom of the cylinder.

Now describing a typical sequence of operations, with reference first to **Figure 8A**, clips are fed onto the clip rail **22**. The clip pusher cylinder **310** extends the rod **310r** to engage the clip pusher pawl **325** with the clips **14** and push the clips **14** in the feed direction. **Figure 7** illustrates the retraction assembly **200** during this operation. Then, after a dual clip application, or when a single clip application is desired, as shown in **Figure 8B**, the clip pusher cylinder **310** retracts the rod **310r** until the clip pusher pawl **325** is against the stop anvil **328** and the pawl **325** disengages the clips **14**. **Figure 7** shows that, starting with the cylinder **210** holding the rod **210r** in an extended state, air is applied to the rod side of the cylinder **210** causing the cylinder rod **210r** to retract. As the cylinder **210** and rod **210r** retract, the legs **226, 227** of the retraction jaw **225** start to close and complete their travel to a closed position to engage the clips **14** as shown in **Figure 9A**. The retraction jaw legs **226, 227** are drawn together by the extension spring **228**. The timing of the jaw closure can allow the teeth **226t, 227t** to engage the clip legs **14L** (**Figure 9C**) prior to the retraction cylinder **210** reaching full stroke. Once the retraction jaw teeth **226t, 227t** firmly engage the clips **14**, the remaining stroke of the cylinder **210** allows the rod **210r** to pull the clips **14** away from the clip window and associated attachment mechanism. By preventing a clip from being fed into the attachment device, no clip is applied via the first clip mechanism thereby allowing a single clip to be applied to the product. This operational configuration can remain until the end of the chain of chubs, at which time a double set of clips may be desired as noted above. A knife cut

can be made intermediate the dual applied clips to start a new chain and/or release the first chain (shown at position "k" in **Figure 2B**). The length and number of chubs can vary as noted above. During the time period from the last single clip application and the end of the chub chain, where a double clip and knife cut is applied, the retraction jaw **225** can return to its rest configuration with the stop jaw pins $\mathbf{230_1}$, $\mathbf{230_2}$ forcing the legs to open as shown in **Figure 7** and described further above.

The operation and sequence of events can be controlled by a programmable logic controller. The number of pieces in the chain and/or length of the chain can be selected by an operator input using a Human Machine Interface to communicate with the controller as is well known to those of skill in the art.

Figure 10 is a block diagram of exemplary embodiments of data processing systems that illustrates systems, methods, and computer program products in accordance with embodiments of the present invention. The processor **410** communicates with the memory **414** via an address/data bus **448**. The processor **410** can be any commercially available or custom microprocessor. The memory **414** is representative of the overall hierarchy of memory devices containing the software and data used to implement the functionality of the data processing system **405**. The memory **414** can include, but is not limited to, the following types of devices: cache, ROM, PROM, EPROM, EEPROM, flash memory, SRAM, and DRAM.

As shown in **Figure 10**, the memory **414** may include several categories of software and data used in the data processing system **405**: the operating system **452**; the application programs **454**; the input/output (I/O) device drivers **458**; the clip push/pull control module **450**; and the data **456**.

The data **456** may include a look-up chart of different products, filling rates, selectable chain lengths and link lengths and the like **451** corresponding to particular or target products for one or more producers, which may be displayed to allow an operator to select desired operational parameters at the start of each shift and/or production run and the like.

As will be appreciated by those of skill in the art, the operating system **452** may be any operating system suitable for use with a data processing system, such as OS/2, AIX, DOS, OS/390 or System390 from International Business Machines Corporation, Armonk, NY, Windows CE, Windows NT, Windows95, Windows98 or Windows2000 from Microsoft Corporation, Redmond, WA, Unix or Linux or

FreeBSD, Palm OS from Palm, Inc., Mac OS from Apple Computer, LabView, or proprietary operating systems. The I/O device drivers **458** typically include software routines accessed through the operating system **452** by the application programs **454** to communicate with devices such as I/O data port(s), data storage **456** and certain memory **414** components and/or the dispensing system **420**. The application programs **454** are illustrative of the programs that implement the various features of the data processing system **405** and preferably include at least one application which supports operations according to embodiments of the present invention. Finally, the data **456** represents the static and dynamic data used by the application programs **454**, the operating system **452**, the I/O device drivers **458**, and other software programs that may reside in the memory **414.**

While the present invention is illustrated, for example, with reference to the clip push/pull module **450** being an application program in **Figure 10**, as will be appreciated by those of skill in the art, other configurations may also be utilized while still benefiting from the teachings of the present invention. For example, the module **450** may also be incorporated into the operating system **452**, the I/O device drivers **458** or other such logical division of the data processing system **405**. Thus, the present invention should not be construed as limited to the configuration of **Figure 10**, which is intended to encompass any configuration capable of carrying out the operations described herein.

The I/O data port can be used to transfer information between the data processing system **405** and the closure attachment mechanism (such as for chubbed linked product) **420** or another computer system or a network (*e.g.*, the Internet) or to other devices controlled by the processor. These components may be conventional components such as those used in many conventional data processing systems which may be configured in accordance with the present invention to operate as described herein.

While the present invention is illustrated, for example, with reference to particular divisions of programs, functions and memories, the present invention should not be construed as limited to such logical divisions. Thus, the present invention should not be construed as limited to the configuration of **Figure 10** but is intended to encompass any configuration capable of carrying out the operations described herein.

The flowcharts and block diagrams of certain of the figures herein illustrate the architecture, functionality, and operation of possible implementations of selective implementation of single and dual clip closure means according to the present invention. In this regard, each block in the flow charts or block diagrams represents a module, segment, or portion of code, which comprises one or more executable instructions for implementing the specified logical function(s). It should also be noted that in some alternative implementations, the functions noted in the blocks may occur out of the order noted in the figures. For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved.

The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although a few exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the claims. In the claims, means-plus-function clauses, where used, are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Therefore, it is to be understood that the foregoing is illustrative of the present invention and is not to be construed as limited to the specific embodiments disclosed, and that modifications to the disclosed embodiments, as well as other embodiments, are intended to be included within the scope of the appended claims. The invention is defined by the following claims, with equivalents of the claims to be included therein.